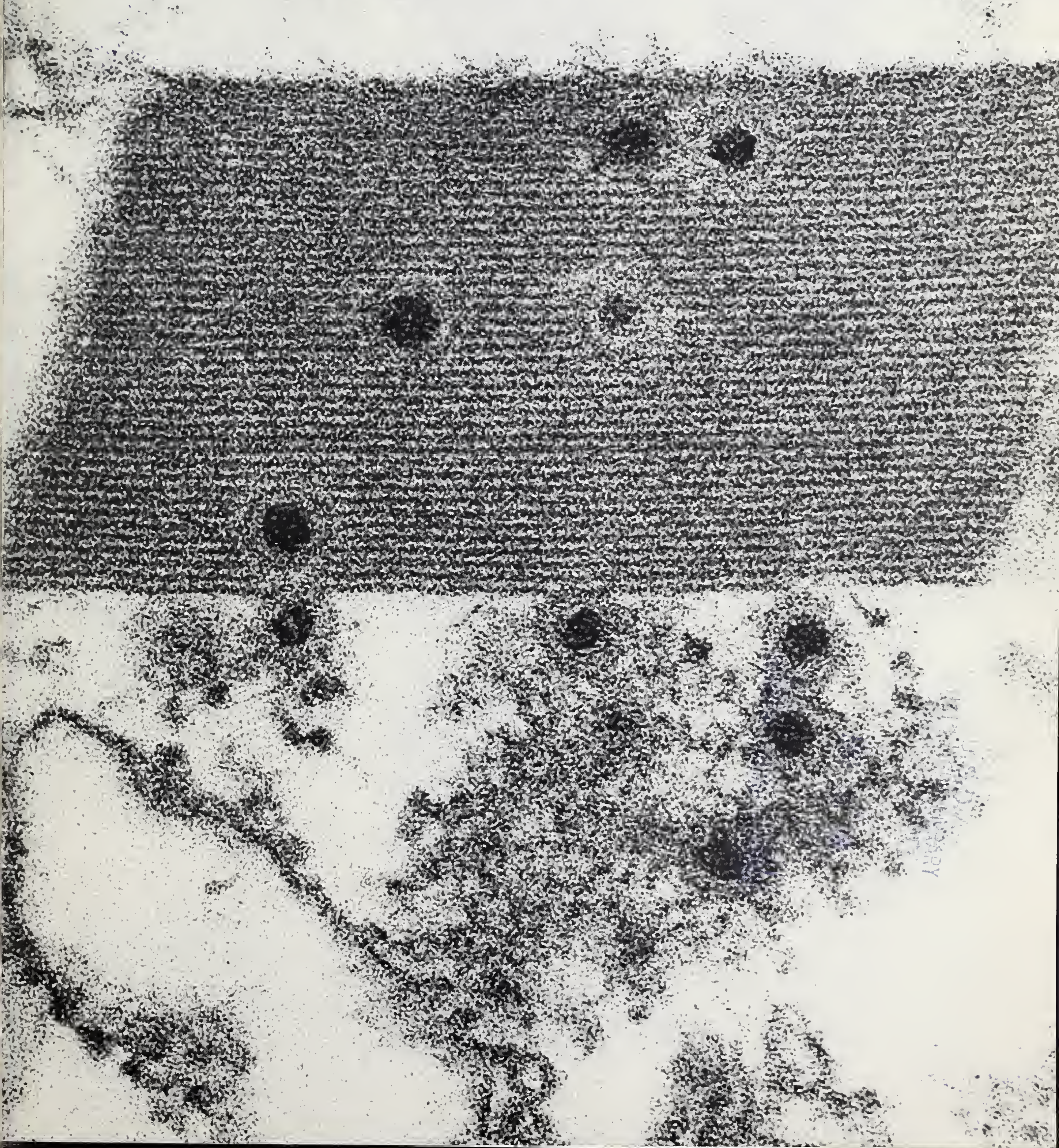
U.S. Department of Agriculture Science and Education Administration
April 1980

Agricultural Research



Report to the President and Congress on the Fiscal 1981 Budget—An Overview

The Users Advisory Board*

The Nation's current economic situation is not a happy one, and is being compounded by worsening inflation and an unsatisfactory balance of foreign trade.

Given these factors, we are pleased to see the President's budget in agreement with our own high priorities for basic research and integrated pest management. . . .

Above and beyond the difficulties wrought by inflation and our own interests, we wish to point out that the Secretary of Agriculture has expanded the concerns of the Department beyond the traditional "farm gate" to marketing, nutrition, consumer, and environmental areas. . . .

We believe it is incumbent on ourselves and the Government to make the best use of our total resources. Food and agricultural production is critically important to our economy and is a renewable, highly efficient resource. Food security (in terms of quantity as well as equity of distribution) is among the most basic of national and human needs and rights. The President's own Commission on World Hunger has pointed out that food needs are real and not expected to markedly improve soon. . . .

Among those items we wish to highlight for Presidential and Congressional concern are the following:

• Our concern for the economic and social implications of the U.S. farm and rural structure. Our concern focuses on *all* family-owned farms, not just small farms. . . .

• Our concern for basic research relative to the food and agricultural sciences. We support the competitive grants program; and we support broadening the range of subjects for which competitive grants are offered.

• Our concern for the need to improve and expand implementation of integrated pest management (IPM) programs through research and extension. . . .

• Our concern for the need to develop and implement new technologies and practices which will reduce agriculture's dependence on petroleum energy. . . .

• Our concern that providing adequate quantities and quality of water for agricultural use is a growing problem. Increasing competition for water by multiple interests is generating increasing need to develop and extend new water use and management technologies, practices, and policies. We recommend research to develop innovative, new alternatives to and improvements in irrigated agriculture with priority for water use efficiency.

• Our concern for development and maintenance of both national and worldwide food security. We define food security to include concern for the overall quantity of food produced, as well as for equity in quality and distribution. . . .

• Our concern that human nutrition is neither well understood nor adequately dealt with in national policy and education. . . .

• Our concern that continuing disappearance and depletion of agricultural land and soil threaten a necessary and basic national resource. We are equally concerned with loss in soil quality and the quantitative removal of agricultural land from agricultural use. . . . We support new and extensive soil land management and preservation education programs and studies which would lead to the setting of national soil conservation and agricultural land preservation goals. . . .

*The National Agricultural Research and Extension Users Advisory Board, consisting of 21 citizens, was established by Congress in the 1977 Farm Bill as an independent advisory group to provide for direct citizen participation at the highest levels of agricultural research and extension programs and budget planning. Members of the board recommend agricultural research and extension needs and priorities to the President, the Secretary of Agriculture and Congress. Newly elected board chairman is John Rougan, state veterinarian for the Tennessee Department of Agriculture. Ellen Haas, president of the Consumer Federation of America is vice chairman. A complete copy of the board's recommendations is available from James Meyers, SEA/USDA, Room 351-A, Washington, D.C. 20250.

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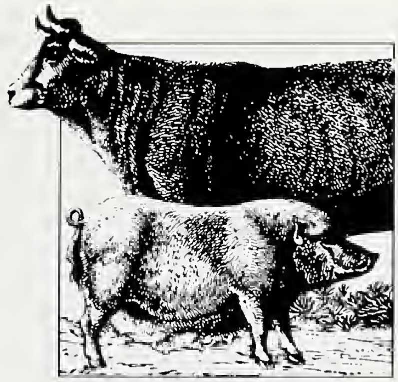
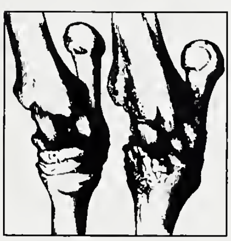
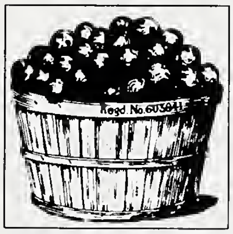
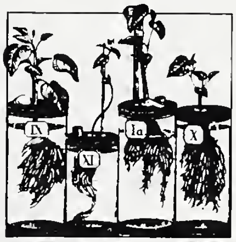
Photos pp.11, 13, and 15 courtesy Grant Heilman.

Cover: An interdisciplinary research team at SEA's Arthropod-Borne Animal Diseases Research Laboratory is studying Bluetongue virus, its insect carrier, and infected host animals. This electromicrograph of spherical-shaped BT virus particles in baby hamster kidney cells is magnified 410,000 times (PN-6803).









The Riddle of Bluetongue

Of all the livestock diseases in this country, scientists may never find one more difficult, fascinating, or complex than bluetongue.

Currently there is no proven nor economical way to control it, and many signs of illness can be attributed to several other diseases, say scientists at SEA's Arthropod-Borne Animal Diseases Research Laboratory, Denver, Colo.

Many farmers and ranchers are reluctant to discuss bluetongue, or even admit having problems. Thus, total economic damage from the disease is very hard to assess.

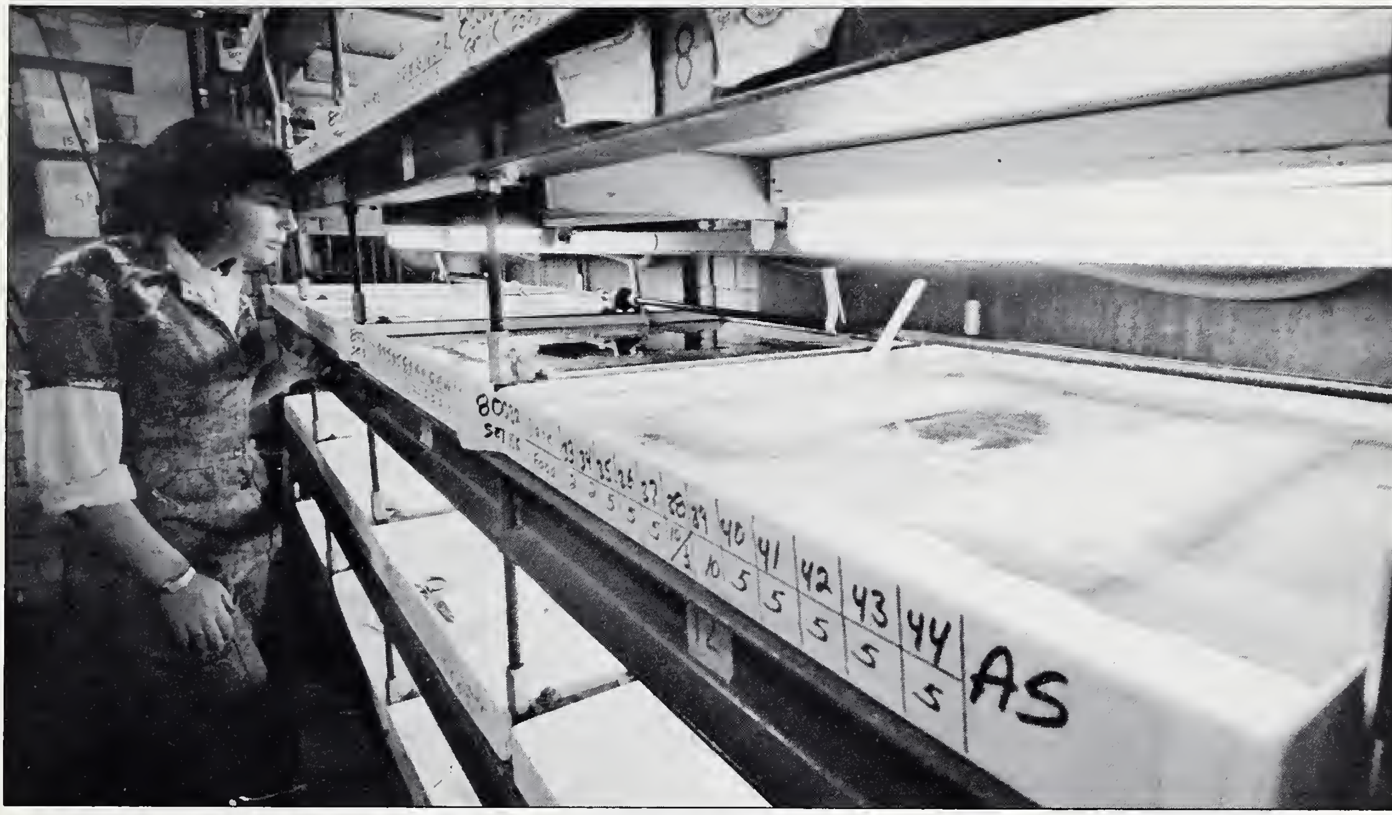
Sheep are the most susceptible domestic animals; goats are considerably more resistant than sheep—cattle somewhere in the middle. Whitetail deer are highly susceptible.

Bluetongue (BT) is a serious viral disease of livestock. Its first signs in cattle are swollen lips, gums and tongues, and saliva sometimes hangs from the mouth in long strands. Sheep with the disease have fever, swollen mouths, and deformed hoofs. Later, infected females abort or have deformed offspring.

Scientists have isolated BT virus from sheep, cattle, goats, and wild ruminants in 32 states. However, because the virus is often difficult to isolate, even cattle in other states could have it. Four of the 20 known serotypes of BT virus occur in the United States. Indirect evidence of BT infection, based on serologic tests for antibody in blood samples, has been found in ruminants in every state but Alaska and Rhode Island.

Veterinarians with USDA's Animal and Plant Health Inspection Service (APHIS) have completed a national survey for the presence of BT

Research entomologist David Akey (seated) and biological technician Charles McKinnon handle BT virus-infected insects in isolation units. A new ozone purge technique is being developed to kill any remaining infected flies in the units and to insure decontamination of all equipment in the isolation units (0280X141-3).



Above: Biological aid Arlene Scaroni inspects larvae and pupae of *C. variipennis* being reared for later use in BT virus infection and transmission studies (0280X146-34).

Far left: The tiny gnat, *Culiocoides variipennis,* that carries and transmits BT virus is about 1/10 the size of a mosquito (0280X152-26).

Left: While observing virus particles and pathologic changes in infected tissue, biological lab technician Majorie Alders adjusts a BT virus specimen in the electron microscope (0280X145-16).

antibody using blood obtained from cattle at the time of slaughter.

"This survey should provide us with better information on where bluetongue is most prevalent," says veterinarian Thomas E. Walton, director of the SEA lab in Denver.

A tiny gnat, sometimes known as a "no-see-um," is the primary vector for BT virus. The gnat, *Culicoides variipennis,* is found throughout most of the United States, and has always been found in areas of BT outbreaks. Female gnats feed on a variety of animals and require blood for egg development.

SEA entomologist Robert H. Jones is studying the gnat. He said that wild field populations of *C. variipennis* vary greatly in their oral susceptibility to BT virus.

"To have an outbreak of bluetongue," Jones says, "we know three conditions must be met. We must have the proper virus strain, susceptible animals, and the gnats must also be susceptible to the virus."

Genetic control of the gnats may be one way of attacking BT. Jones has found that the gnat's ability to transmit BT virus is genetically controlled—some populations have a low susceptibility, while others have a high one. This information could be used to control BT virus transmission by releasing gnats of low susceptibility in an area where gnats are highly susceptible to make the indigenous population more resistant to infection.

Typical farm breeding sites for the gnats are areas polluted by livestock wastes—quiet water along pond edges, ditches, streams, and overflow areas from septic and stock water tanks. Pesticide spraying may be a short-term solution, but no pesticides are registered for use against this gnat. The most promising control method, but a long term one, is modification of the larval habitat through water management.

Along with the gnats, other biting insects may also transmit BT, but as yet none have been identified.

Microbiologist Neil Foster, also at the Denver lab, has found that the double-stranded ribonucleic acid (RNA) genome of BT virus may be extracted as an unfragmented, continuous structure. Genome circularity probably makes the virus more stable than linear or fragmented genomes and thus more resistant to heat and chemical inactivation. For example, this resistance of the genome to chemical inactivation has been shown in work to develop an inactivated vaccine.

Foster has also found abnormalities and virus-like particles in BT-infected bull's spermatozoa. Foster said that although other disease agents have been found in semen, no other livestock viruses are presently known to enter the spermatozoa.

SEA veterinarian T. Lynwood Barber worked under a federal-state-industry cooperative agreement during 1977-78 at the University of California, Davis, to develop an inactivated (killed) vaccine for BT in sheep.

A killed vacine is preferable over a modified-live one, Barber said, because it does not spread a live virus through the animal population.

In his work at Davis, Barber and his UCD colleagues made a surprising discovery. "The killed vaccine we developed does not cause sheep to produce neutralizing antibodies," he said. "We were looking for the traditional antibody response, and didn't find it. We were surprised to find that vaccinated animals were protected from the virus."

"We have proved that we can protect an animal from infection by using killed virus in the BT vaccine," Barber said. "Now it may be possible to develop a vaccine that will protect against all 4 American serotypes of BT virus. Shared antigens of the serotypes may give enough cross-protection so that all 4 serotypes do not have to be included in the vaccine."

Barber said that more research will be needed, however, to produce a multi-serotype killed vaccine that will protect cattle, as well as sheep.

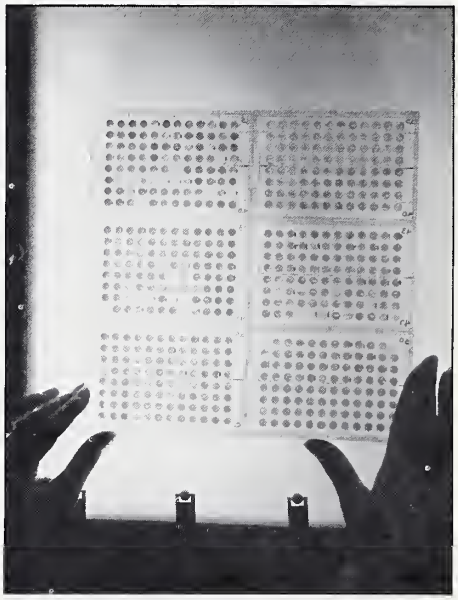
Mechanical transmission of BT virus (for example, when the same hypodermic needle is used on two animals) is a possibility, according to SEA veterinarian Albert J. Luedke. "Because the virus is closely associated with the red blood cells of infected animals, any procedure that results in transfer of small amounts of blood from an infected to a susceptible animal may transfer the virus," he said.

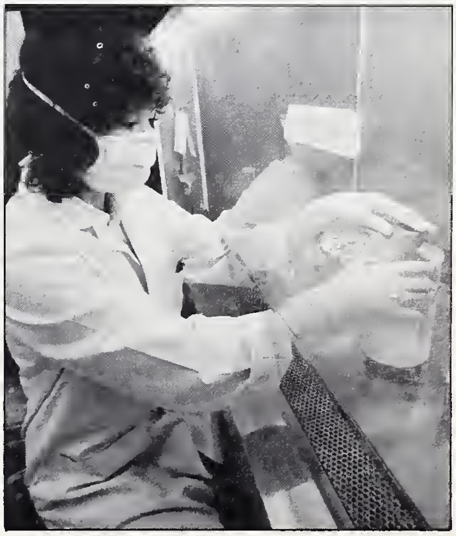
Vertical transmission—from dam through placenta to unborn calf—is the latest discovery of BT virus spread, he said. "We've suspected this type of transmission for a long time, and recently proved it experimentally."

"We've found the virus in semen of infected bulls that did not appear to have bluetongue," he said, "and the virus may be transmitted from an infected bull to his calf by natural breeding." Usually in this situation the cow also becomes infected. Studies on artificial insemination transmission have not yet been done.

Luedke has bred a BT carrier bull to heifers. This Hereford bull has been latently infected with BT virus since birth and is now 9 years old. Although he has never exhibited any BT signs, the BT virus co-exists in his semen and is latent (dormant) in his body. Even though he appears normal, uninfected gnats that bite him become infected and can pass BT virus to uninfected animals.

In one experiment, Luedke bred this bull to 14 virgin heifers and BT virus was transmitted to all 14. Although the heifers did not get sick, Luedke said, their resulting calves suffered. One heifer aborted, one calf was stillborn, and most of the 12 live calves were weak, uncoordinated, and with varying mild deformities. Five died of unusual disease situations. One weighed only 309 pounds when 1 year old, then rapidly lost weight and died 45 days later, weighing 190 pounds. Only 6 of the 12 are still alive after 3 years.





This bull was also the first of several cattle to exhibit "showering" of BT virus, according to Luedke. The latent virus can be activated to "shower" into the blood stream by bites from normal gnats. Within four hours, other uninfected gnats can pick up BT virus by biting these carrier bulls and transmit virus to susceptible ruminants.

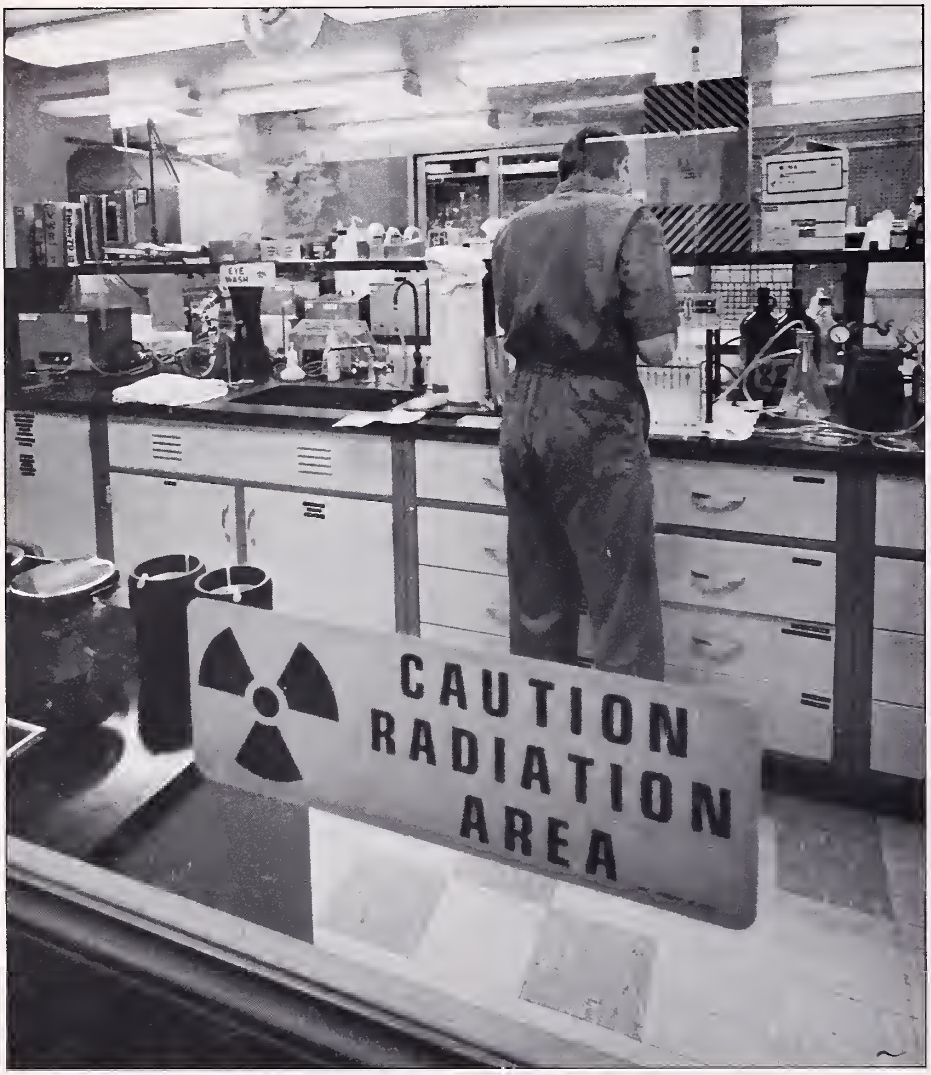
Obviously, much more research is needed. Ways to control the biting gnat that spreads BT must be found. A multi-strain vaccine for both sheep and cattle must be developed. More in-

Above: Luedke holds an insect-filled container on a sheep's abdomen to permit insect feeding. The insects will either transmit or become infected with BT virus (0280X143-18A).

Top right: Tell-tale BT virus signs in sheep include lesions on the muzzle and swollen ears (0280X142-15A).

Right: Uninfected cells grown in plastic panels are later infected with BT virus to count and determine anti-body concentrations in the serum of infected animals (0280X142-23A).

Bottom right: Working in a biological safety cabinet to insure a sterile environment, biological aid Yvonne Reed prepares cells for growth in containers for future viral assays (0280X145-4).



Above: Michael Jochim adds radioisotopes to lymphocytes collected from BT virus-infected animals to assess the animals' immunologic response to the virus (0280X146-28).

Right: Research entomologist Fred Holbrook uses a specialized wind tunnel to test pesticide effectiveness against adult *C. variipennis*. Flies contained in the tunnel's downwind end are equally covered with virus by finely atomized moisture particles (0280X148-30A).

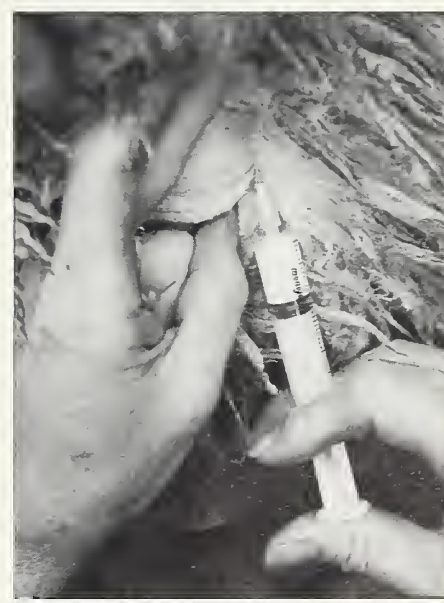
formation must be learned about how the disease is transmitted, the structure of the virus, and how BT affects the animals' reproductive systems.

Also, scientists like SEA veterinarian Michael M. Jochim, who is currently developing and improving serologic diagnostic tests for the virus, must continue their work.

Dr. Thomas E. Walton, Dr. Robert H. Jones, Dr. Neil M. Foster, Dr. T. Lynwood Barber, Dr. Albert J. Luedke, and Dr. Michael M. Jochim are located at the SEA Arthropod-Borne Animal Diseases Research Laboratory, Bldg. 45, Entrance B, P.O. Box 25327, Denver, CO 80225.—(By Dennis Senft, SEA, Oakland, Calif., and Marci Memolo, formerly of SEA Information, Washington, D.C.)

Because of bluetongue, Australia and New Zealand refuse to accept U. S. cattle, semen or embryos –a $10 to $15 million export loss to U. S. cattle producers, according to USDA experts. Neither can U. S. cattle be exported to the United Kingdom –another $10 to $15 million loss in exports.

To export cattle or semen to member countries of the European Economic Community, cattle producers must certify every animal in their herd negative to the modified-direct-complement-fixation test within one year. An additional test is required of the individual animal being exported within 30 days of export. These tests might cost a Montana cattle producer with 100 head more than $1,000 –just to export one animal.



Top left: Ranchers watch as these uninfected sheep are herded for prevaccination inspection by T. Lynwood Barber (0180X054-5A).

Above: "We have proved that we can protect an animal from infection by using killed virus in the BT vaccine. Now it may be possible to develop a vaccine that will protect against all four American serotypes of BT virus." (0180X054-17A).

Bottom: Veterinarian Trevor Collins takes a blood sample before vaccinating sheep with an inactivated bluetongue vaccine (0180X055-14).

Residues—Erosion vs. Energy

Where on the Great Plains are all available crop residues needed to control erosion and restrict environmental pollution? Where might surplus residues be diverted as an alternative source of energy?

Research by SEA soil scientist Edward L. Skidmore, Manhattan, Kans., has produced preliminary answers to these questions.

Straw, small-grain stubble, corn and sorghum stalks—the principal crop residues of the Great Plains—once were saved for livestock bedding and mulch or were plowed under.

Then USDA scientists took the lead in showing that crop residues are resources to be managed on the land. Under conservation tillage, crop residues can be anchored in the soil to conserve moisture, restrict erosion of valuable topsoil by wind and water, and minimize environmental pollution. Now these residues are being eyed as possible renewable replacements for fossil fuels.

Skidmore developed estimates of average annual residue production of principal crops in the 29 major land-resource areas of the Great Plains. This study broadly identifies crop-location combinations most likely to have residues surplus to needs for wind-erosion control that might be diverted as an energy source.

For individual situations, he is developing a procedure for predicting how much soil loss can be tolerated without impairing the land's productivity or contributing excessively to pollution. Once conservationists have a practical, precise way of making such estimates, they can more accurately identify residues surplus to conservation needs.

The first study involved a major part of 416 counties in 11 states. The 29 major land-resource areas of the Great Plains stretch from the Canadian border south to eastern New Mexico and central Texas, and east from the Rocky Mountain foothills some 400 to 600 miles.

Skidmore computed 1973-1975 average yields of wheat, barley, oats, corn, and sorghum grain in each county, then calculated residue production per hectare based on grain yield. He then subtracted the estimated amount of applied residue that would be lost from tillage and weathering. The resulting residue estimates were compared with the amount needed to control wind erosion in each land-resource area as determined by computer solution of a USDA wind-erosion equation.

Residue needed was defined as what would restrict potential average annual soil loss by wind erosion to no more than 5 tons per acre each year on wide, smooth fields. Skidmore then classified the land-resource areas as deficit, residue surplus less than 1,000 pounds per acre, and surplus of more than 1,000 pounds per acre.

Wheat produces more residue than the other four main Great Plains crops combined. But more than 1,000 pounds of surplus wheat residue per acre can be expected only along the eastern side of the Plains from central Nebraska to central Texas, and in part of Minnesota's Red River Valley.

Wheat does not normally yield enough residue to control wind erosion in northern Montana, most of North Dakota, South Dakota east of the Missouri River, and on the western half of the Great Plains stretching from southeastern Wyoming south to New Mexico and west Texas.

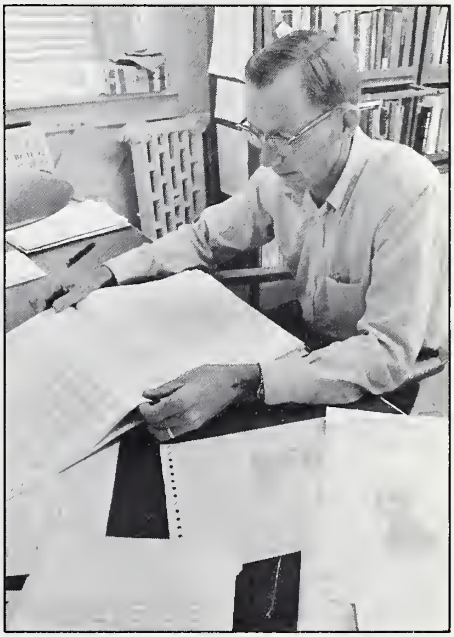
Surplus corn residue of more than 1,000 pounds per acre can be expected, Skidmore found, in most of the Great Plains south of South Dakota. Corn residue deficit areas are in eastern Kansas, most of New Mexico, much of South Dakota, and in northern Montana and most of North Dakota where corn seldom is grown for grain.

Skidmore says oats, barley, and sorghum do not produce large quantities of residue in excess of what is needed to control wind erosion. These of course are broad estimates for large areas and do not take into account localized or field by field differences.

As an approach to estimating how much soil loss can be tolerated in individual fields, Skidmore proposes a mathematical computation based mainly on soil depth. He relates present soil depth to both a lower limit in depth, below which further soil loss would reduce productivity, and an upper limit beyond which increased soil depth would not add to productivity.

Also included in the calculations are the soil's renewal rate and an annual soil loss limit where damage costs to the environment become greater than costs of preventing the loss.

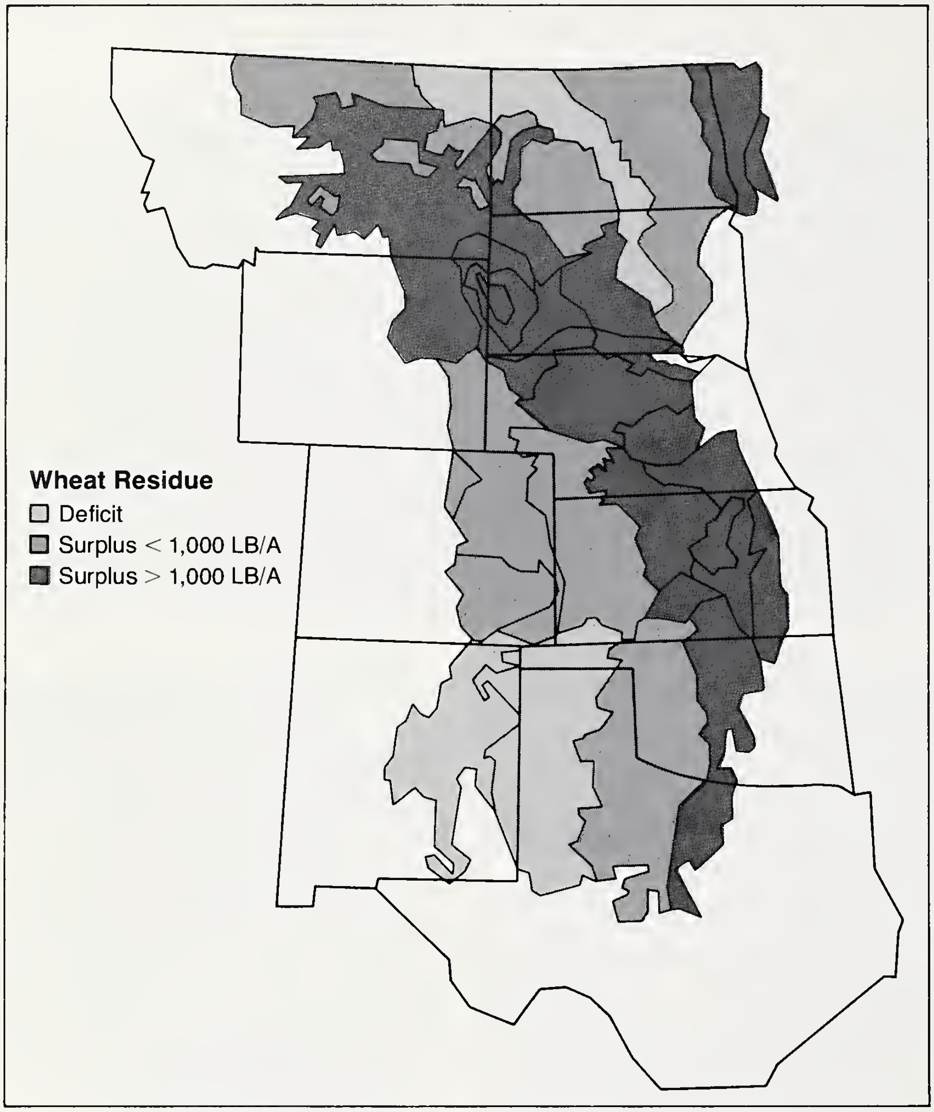
As an example, Skidmore applies his formula to a hypothetical soil situation.



Top: A contributing factor to wind erosion is crop residues plowed under.

Above: Skidmore's study identifies crop-location combinations in the 29 major land-resource areas of the Great Plains most likely to have residues surplus to control wind erosion (0180X38-28A).

Left: Under conservation tillage, crop residues left on the soil surface can conserve moisture, restrict wind and water erosion, and minimize environmental pollution (KAN-2018).



This figure shows area in the Great Plains where wheat residue, for the conditions of Skidmore's study, is deficit, has a surplus less than 1,000 lb./acre, and a surplus of more than 1,000 lb./acre for controlling potential average annual soil loss from wind erosion to 5.0 tons/acre/year on wide, smooth fields (PN-6802).

Suppose soil depth is 4 feet. On this very deep soil, 3 feet is the minimum depth without loss of productivity, 5 feet is the maximum for increased productivity, soil renewal rate is 0.01 inches, and one-tenth inch is the soil loss acceptable for environmental reasons. In this situation, annual soil loss of approximately 6.5 tons per acre could be tolerated.

If soil loss is permitted to change according to the calculated tolerance, Skidmore says the amount lost would not be uniform from year to year. He calculates that soil depth would decrease rather quickly at first and decline to no change as soil loss tolerance approaches the soil renewal rate.

He says information not now available to scientists must be obtained before his soil loss tolerance computation could be put to practical use. More information is needed on renewal rates for specific locations and conditions, and how renewal rates can be accelerated. In addition, Skidmore says more insight is required into the depth that will support particular production levels as well as consensus on how soil depth would be measured.

Removal of crop residues as an energy source must be weighted against the need to maintain productivity and control erosion, Skidmore cautions. Up to 5 tons of soil per acre is lost annually by water erosion from two-thirds of the Nation's cropland. Fifteen percent of the cropland is losing more than 10 tons per acre. And wind erosion is the dominant conservation problem on about 70 million acres of land.

Dr. Edward L. Skidmore's address is 204 Waters Hall, Kansas State University, Manhattan, KS 66506.—(By Walter Martin, SEA, Peoria, Ill.)

Lettuce Wins Fungus Fight

A superparasite shows promise for controlling a fungal disease of lettuce and several other vegetables. The superparasite (a parasite that attacks another parasite) is a newly discovered fungus.

Preliminary tests last summer showed that fungus can be used against fungus to substantially reduce lettuce drop, a serious disease of romaine, iceberg, and Boston lettuce. Losses range from 5 to 20 percent annually and occasionally reach 50 percent, say SEA plant disease specialists Peter Adams and William Ayers.

Adams, a plant pathologist, reports 63 percent less disease in experimental plots that had been inoculated with the superparasite compared to untreated plots. The inoculum was spread over the plots in the spring of 1978 and disked into the soil several times during summer and fall.

Now the researchers are stepping up their efforts to develop a practical method for growing the superparasite in the quantity needed to inoculate large fields. At present the fungus is being grown in sand containing the harmful fungus as a food source. The method is impractical because it takes tons of the sand culture to inoculate one acre.

Ayers, the team's microbiologist, is looking for a synthetic food source on which the superparasite will grow rapidly, or for some substance that will greatly increase its growth rate in the sand culture.

The superparasite, named *Sporidesmium sclerotivorum* by the research team, was invading and killing the harmful fungi in fields around the country long before its discovery. So far the team has identified *S. sclerotivorum* in soil samples from 10 states and suspects that it exists in all 48 continental states. "We're not trying to impose a system nature won't accept," Ayers said. "We're just speeding up nature's slow process by inoculating a diseased field with a large quantity of *S. sclerotivorum."*

The disease fungus, or some of its close relatives, also attack alfalfa, snap beans, onions, peanuts, potatoes, and other vegetable crops, but do not cause as serious an economic loss in these crops.

Because *S. sclerotivorum* needs moisture (at least 50 percent of the water holding capacity of the soil) to invade the harmful fungi, Adams plans to test the superparasite in nonirrigated vs. irrigated fields next summer. He points out, however, that most vegetable crops are irrigated.

Dr. Peter Adams and Dr. William Ayers are located at the SEA Soilborne Diseases Laboratory, B-011A, Beltsville Agricultural Research Center, Beltsville, MD 20705.—(By Judy McBride, SEA, Beltsville, Md.)

Space Saving Crab Apples

Red Delicious apple growers might one day save space, time, and money using crab apples instead of Golden Delicious apples as a pollen source for their orchards.

Among consumers, Red Delicious is the most popular of all apple varieties. As Red Delicious is not self-fruitful, pollen must come—usually carried by insects such as honey bees—from another apple variety. Golden Delicious is a good pollen source and has long been favored by Red Delicious growers for pollenizing needs.

Currently, 2 rows of Goldens are used as a pollen source for 4 rows of Reds. Separate rows must be maintained to insure that apple pickers won't mix the two varieties together in the same bin. Maintaining separate rows of Golden as a pollen source is time-consuming, expensive, and a less than best possible dollar-return use of valuable agricultural land space.

SEA plant physiologist Edward A. Stahly, Wenatchee, Wash., is investigating a better alternative. He's found that crab apples—the small-fruited varieties, not the varieties used to make crab apple jelly—are as good a pollen source for Reds as Goldens, possibly even better. Also, because of their tiny size, crab apples can be easily distinguished from Reds by pickers and can therefore be planted in the same rows as Reds.

Dr. Edward A. Stahly is located at the SEA Fruit Research Laboratory, 1104 North Western Avenue, Wenatchee, WA 98801.—(By Lynn Yarris, SEA, Oakland, Calif.)

Apples are Red

Apples that feel soft or mealy and lack flavor should become a relic of the past once a set of criteria being established to determine stages of fruit maturity is put into use.

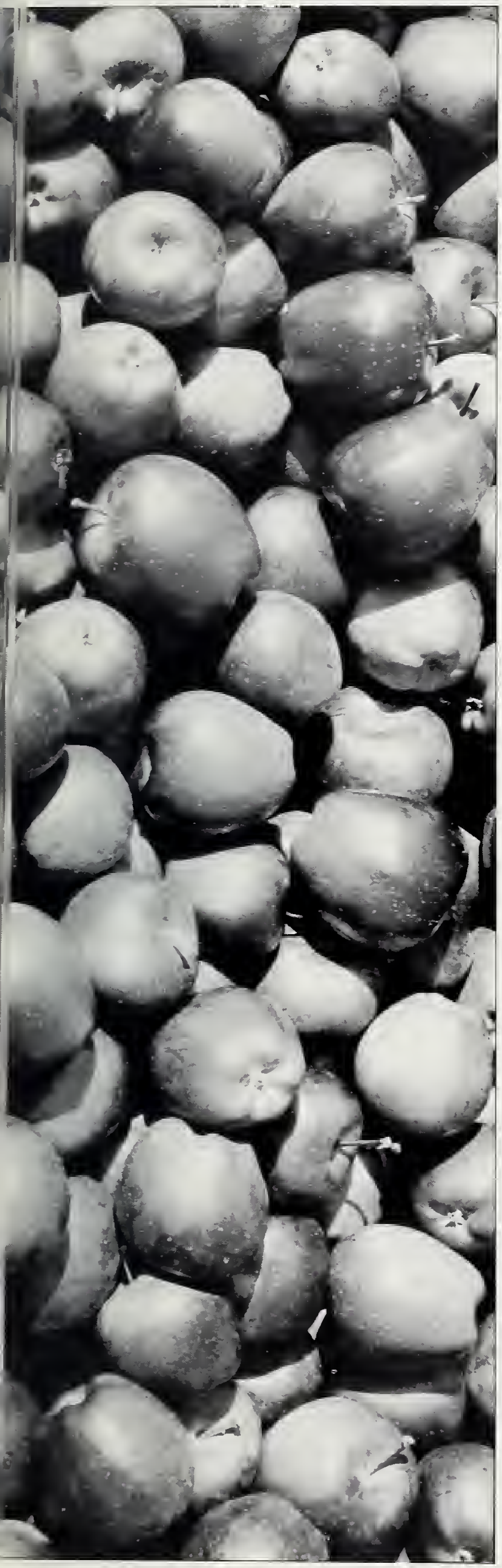
Apple harvesting decisions have always been based on subjective evaluations of fruit maturity; earlier maturing fruit is best suited for storage, later maturing fruit is better suited for fresh-fruit market. Too often, apples intended for storage have been harvested when the fruit was too mature and apples intended for the fresh-fruit market have been harvested when the fruit was not mature enough.

The result of these eyeball decisions has been uneven fruit quality for consumers and an unstable market for growers. For the first time, however, all criteria needed to make an objective decision on fruit maturity and when to harvest apples for a specific market date are being brought together in a single, easy to use package.

Primarily responsible for assembling this package is SEA plant pathologist Kenneth L. Olsen, Wenatchee, Wash. He hopes to have a publication explaining how to use these criteria and relate them to harvesting decisions for the next harvesting season.

The criteria that evaluate fruit maturity are: external fruit color; firmness or soluble solids; flesh or internal fruit color; starch content; and acidity. To measure the criteria, Olsen has designed a series of tests that can be readily used in the orchard by growers and extension agents and requires no special equipment.

Dr. Kenneth L. Olsen is located at the SEA Fruit Research Laboratory, 1104 North Western Avenue, Wenatchee, WA 98801.—(By Lynn Yarris, SEA, Oakland, Calif.)



A Fountain of Youth

Ponce de Leon, the famous Spanish explorer, in searching for a fountain whose misty waters could slow the aging process came up with *nada,* (fountain-wise). SEA researchers seeking the same have met with considerably more success.

A chemical compound—aminoethoxyvinylglycine (AVG)—that slows the aging process of apples in storage may also reduce the time it takes to bring an apple tree into full fruit production and increase the number of apples harvested from each tree.

"AVG stimulated fruit set and more than doubled the annual new growth of trees treated in our tests," says Max W. Williams, SEA plant physiologist at Wenatchee, Wash., and leader of this project. Technically, AVG doesn't actually increase the number of apples grown on each tree, but it does reduce "June drop" (every year a sizable number of apples fall prematurely from their trees in June) which gives the same result—more fruit on the trees.

AVG suppresses the production of endogenous ethylene, the gas that leads to the breakdown of fruit cells in storage. Originally, Williams studied AVG as a means of retarding the ripening process and prolonging apple storage life. In the midst of his study, Williams noted a marked increase in fruit set and vegetative growth of AVG-treated trees.

Normally it can require up to 10 years before non-spur type apple tree varieties, such as Top Red, yield a full crop of fruit. AVG may reduce this time to 4 or 5 years.

It may be several years before AVG is put into commercial use by apple growers. In the meantime, Williams is looking to see if the compound will work on other fruit. Right now, the potential for AVG says Williams, "appears excellent."

Dr. Max W. Williams is located at the SEA Fruit Research Laboratory, 1104 North Western Avenue, Wenatchee, WA 98801.—(By Lynn Yarris, SEA, Oakland, Calif.)

A Shot of Iron

A shot of iron seems just the tonic some apple and pear trees in the Pacific Northwest need to overcome a common iron deficiency.

Called iron chlorosis, the iron deficiency has been present in the Northwest for years. Standard treatments, such as iron chelate sprays, exist and are effective in most orchards. However, for reasons unknown, some orchards do not respond to standard treatments even though stricken trees display classical iron chlorosis symptoms—a rapid decline and death. Since it takes at least 9 years to get another tree into full fruit production, growers cannot sustain many losses.

SEA plant physiologist J. Thomas Raese and plant pathologist Curtis Lee Parish, Wenatchee, Wash., have been able to improve the situation within a few days by injecting 2 quarts of one-percent iron sulfate solution directly into the trunk of an ailing tree. Their treatment has worked perfectly so far in correcting the iron deficiency problems of trees that won't respond to standard chlorosis treatments.

Currently Raese and Parish are trying to determine the best time for the injections to be made. They hope to have treatment guidelines for Anjou and Bartlett pear trees ready by next spring. Cooperating with the SEA researchers on this project are Washington State University soil scientist Burt Koch at Wenatchee, and the University of California.

Dr. J. Thomas Raese and Dr. Curtis Lee Parish are located at the SEA Fruit Research Laboratory, 1104 North Western Avenue, Wenatchee, WA 98801.—(By Lynn Yarris, SEA, Oakland, Calif.)

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Agrisearch Notes

Liver Fluke Diagnostic Test—The world's first diagnostic test for liver fluke in cattle has been developed. The new test should make finding a cure for fluke easier by quickly and reliably determining whether or not cattle are infested with liver fluke.

Liver fluke, *Fasciola hepatica,* are parasitic flatworms that infest and feed on bovine livers. There is no treatment currently available in the U.S. for fluke, which each year costs the cattle industry millions of dollars in livers condemned at the slaughterhouse, plus losses from reduced milk production and calf growth.

Until the new diagnostic test, the only way to detect fluke infestations has been to place cattle feces in water and search for fluke eggs—a method both time-consuming and inaccurate.

SEA microbiologist David Shen and Carla Farrell, a scientist with Washington State University, both at Pullman, Wash., developed the new test, which, in addition to diagnosing for fluke, should also enable researchers to evaluate the effectiveness of proposed fluke treatments.

The basis of Shen's and Farrell's test is a protein detection technique used in human and plant disease research called ELISA, which stands for enzyme-linked immunosorbent assay (Agricultural Research, April 1978, pg. 13). Using ELISA, a specimen of blood or serum is placed in a colorless enzyme solution. If a suspect protein, such as a virus or an antibody, is present in the specimen, the enzyme solution turns a specific color.

Shen and Farrell are believed to be among the first to adapt ELISA to animal disease research. Currently, they are working on developing an ELISA diagnostic test for equine infectious anemia in horses and distemper in dogs.

Dr. David Shen and Carla Farrell are located at the Veterinary Science Building, Dept. of Vet. Microbiology and Pathology, Washington State University, Pullman, WA 99164.—(By Lynn Yarris, SEA, Oakland, Calif.)

New Plant Culture Technique—Old World cottons are incompatible with New World cottons and require many hundreds of cross fertilization attempts to obtain a few hybrid seeds. Many of the wild species are also very difficult to cross (hybridize) with cultivated cotton and in several cases hybrids have not been obtained.

A plant breeding process that bypasses many conventional problems in crossing plants has been developed. The new technique accomplishes the first step in transferring desirable genetic traits from wild cotton species to domestic ones, according to SEA's plant physiologist James McD. Stewart and biological technician Cecilia L. Hsu.

This process increases the possibility for such desirable traits as wilt resistance and cold tolerance to be introduced into domestic varieties. The new seed culture technique permits the growth of hybrid embryos from fertilization to germination with less manipulation and a larger yield of living plants.

The transfer of genetic traits from a wild species to a domestic one often is difficult and time-consuming. Some hybrid embryos die in the early stages of development when their own food source fails to develop. The newly developed procedure permits germ free removal of 2-day old seeds from plant ovaries in a rapid and efficient manner without the need for dissection of immature embryos. The seeds containing the hybrid embryos are then grown without changing the growth medium during the 8-to-10-week growing period.

The culture technique will be useful in expanding the germplasm base of commercial cotton. The possibility exists for the development of glandless cotton seeds from glanded cotton plants as a result of using wild Australian species. The transfer of this trait to commercial cotton will aid oil and meal processors and at the same time provide growers with a plant with considerable insect resistance.

So far, 18 hybrid combinations have proved easier to accomplish through culture than through conventional techniques. In fact, 7 of the hybrids involving wild species and cultivated cotton have not been obtained previously.

Dr. James McD. Stewart and Cecilia Hsu are located at the Dept. of Plant and Soil Science, University of Tennessee, Knoxville, TN 37916.—(By Eriks Likums, SEA, New Orleans, La.)